

Amendments to the Claims:

Claim 1 (cancel)

Claim 2 (new): A method for operating a premixed charge, compression ignition engine, the engine having a cylinder and a piston moveable in the cylinder, and the method comprising the steps of:

providing in the cylinder a gaseous medium containing oxygen;

forming a combustible mixture by mixing generally homogeneously into the gaseous medium a first fuel that tends to autoignite relatively less readily and a second fuel that tends to autoignite relatively more readily; and

compressing the combustible mixture with the piston until combustion starts, wherein combustion starts at multiple ignition sites distributed throughout the combustible mixture after a delay in a timing of the start of combustion determined by a ratio of the first fuel to the second fuel.

Claim 3 (new): The method of claim 2 wherein the first fuel is gaseous and the second fuel is a liquid having a relatively high cetane number.

Claim 4 (new): A method for operating a premixed charge, compression ignition engine, the engine having a cylinder and a piston moveable in the cylinder, and the method comprising the steps of:

providing in the cylinder a gaseous medium containing oxygen;

forming a combustible mixture by mixing generally homogeneously into the gaseous medium a first fuel that tends to autoignite relatively less readily and a second fuel that tends to autoignite relatively more readily;

compressing the combustible mixture with the piston until combustion starts, wherein combustion starts at multiple ignition sites distributed throughout the combustible mixture after a delay in a timing of the start of combustion determined by a ratio of the first fuel to the second fuel; and

controlling the timing of the start of combustion by varying the ratio of the amount of the first fuel to the amount of the second fuel.

Claim 5 (new): The method of claim 4 wherein the method further comprises advancing the timing of the start of combustion by decreasing the ratio of the amount of the first fuel to the amount of the second fuel.

Claim 6 (new): The method of claim 5 wherein an operation cycle of the engine includes an intake event, a compression event, a combustion event and an expansion event; said timing of the start of combustion being a function of engine speed; and wherein the method further comprises the steps of:

controlling the power provided by the engine by varying the total amount of the first fuel and the second fuel provided in the combustible mixture;

determining the ratio of the first fuel to said second fuel giving a desired timing of the start of combustion; and

mixing into the combustible mixture for a cycle an amount of said second fuel giving said desired timing of the start of combustion.

Claim 7 (new): The method of claim 6 wherein the method further comprises the step of adding a portion of exhaust gases into said gaseous medium to control the duration of the combustion event.

Claim 8 (new): A method of operating an engine, comprising the steps of:

mixing a first fuel, a second fuel and oxygen in a cylinder when a piston is approximately between 180 degrees and 60 degrees before a top dead center position;

varying a timing of a start of combustion at least in part by providing the first fuel and the second fuel to the cylinder in a determined ratio;

initiating combustion by compression igniting the mixture when the piston is between 20 crank angle degrees before the top dead center position and 10 crank angle degrees after the top dead center position.

Claim 9 (new): The method of claim 8 wherein said mixing step includes a step of injecting liquid fuel from a fuel injector directly into the cylinder.

Claim 10 (new): The method of claim 8 wherein said mixing step includes a step of routing a gaseous fuel into the cylinder.

Claim 11 (new): The method of claim 8 wherein said mixing step includes a step of providing compressed air to the cylinder.

Claim 12 (new): The method of claim 8 wherein said varying step includes a step of retarding said timing of the start of combustion at least in part by reducing a ratio of fuel with a high cetane number relative to fuel with a low cetane number.

Claim 13 (new): The method of claim 8 wherein said varying step includes a step of advancing said timing of the start of combustion at least in part by increasing a ratio of fuel with a high cetane number relative to fuel with a low cetane number.

Claim 14 (new): The method of claim 8 including a step of adjusting combustion duration at least in part by recirculating exhaust gases into the cylinder.

Claim 15 (new): An engine comprising;
an engine body with at least one cylinder;
a piston slidably positioned in each said at least one cylinder, and being movable between a bottom dead center position and a top dead center position;
a liquid fuel supply valve attached to said engine body;
a gaseous fuel supply valve attached to said engine body;
an electronic control unit in control communication with said liquid fuel supply valve and said gaseous fuel supply valve, and being operable to actuate said liquid fuel supply valve when said piston is approximately between 180 degrees and 60 degrees before the top dead center position.

Claim 16 (new): The engine of claim 15 wherein said liquid fuel supply valve is a fuel injector positioned to inject fuel directly into said cylinder.

Claim 17 (new): The engine of claim 15 including an exhaust gas recirculation system attached to said engine body.

Claim 18 (new): The engine of claim 15 including a turbocharger operably coupled to said cylinder.

Claim 19 (new): The engine of claim 15 wherein said electronic control unit functions to determine a change to the ratio of a liquid fuel to a gaseous fuel supplied to said cylinder.

Claim 20 (new): A premixed charge compression ignition internal combustion engine, comprising:

- an engine body;

- a combustion chamber formed in the engine body;

- an intake air system for delivering intake air, including at least one of air and a mixture of air and fuel, to said combustion chamber;

- combustion control system for controlling combustion events to reduce emissions, said combustion history control system including a mixture autoignition property control system for varying an autoignition property of the mixture, said mixture autoignition property control system including a first fuel supply for supplying a first fuel to the engine and a second fuel supply connected to at least one of said intake air system and said combustion chamber for supplying a second fuel to the engine, said first fuel having a first autoignition property and said second fuel having a second autoignition property different from said first autoignition property; and

- a processor adapted to control an amount of said second fuel delivered to said at least one of said intake air system and said combustion chamber.

Claim 21 (new): A method for operating a homogeneous charge, compression ignition engine, the engine having a cylinder and a piston moveable in the cylinder, and the method comprising the steps of:

- providing in the cylinder a gaseous medium containing oxygen;
- forming a combustible mixture by mixing generally homogeneously into the gaseous medium a first fluid fuel that is relatively difficult to ignite and a second fluid fuel that is relatively easy to ignite; and
- compressing the combustible mixture with the piston until combustion starts generally simultaneously at a plurality of locations distributed throughout the combustible mixture after an ignition delay determined by the proportion of the first fuel to the second fuel.

Claim 22 (new): The method of claim 21 wherein the first fuel is gaseous and the second fuel is a liquid having a relatively high cetane number.

Claim 23 (new): A method for operating a homogenous charge, compression ignition engine, the engine having a cylinder and a piston moveable in the cylinder, and the method comprising the steps of:

- providing in the cylinder a gaseous medium containing oxygen;
- forming a combustible mixture by mixing generally homogeneously into the gaseous medium a first fluid fuel that is relatively difficult to ignite and a second fluid fuel that is relatively easy to ignite;
- compressing the combustible mixture with the piston until combustion starts generally simultaneously at a plurality of locations distributed throughout the combustible mixture after an ignition delay determined by the proportion of the first fuel to the second fuel; and
- wherein the ignition delay begins when the piston is at a predetermined rotational position relative to top dead center and wherein the method further comprises the step of controlling the ignition delay by varying the ratio of the amount of the first fuel to the amount of the second fuel.

Claim 24 (new): The method of claim 23 wherein the method further comprises shortening the ignition delay by decreasing the ratio of the amount of the first fuel to the amount of the second fuel.

Claim 25 (new): The method of claim 24 wherein the method further comprises the step of recirculating a portion of exhaust gases into said gaseous medium to control a duration of the combustion phase.

Claim 26 (new): A method of operating an engine, comprising the steps of:
mixing a first fuel, a second fuel and oxygen in a cylinder when a piston is closer to a bottom dead center position than to a top dead center position;
adjusting an ignition delay at least in part by providing the first fuel and the second fuel to the cylinder in a determined proportion;
compression igniting the mixture when the piston is closer to the top dead center position than the bottom dead center position.

Claim 27 (new): The method of claim 26 wherein said mixing step includes a step of injecting liquid fuel from a fuel injector directly into the cylinder.

Claim 28 (new): The method of claim 26 wherein said mixing step includes a step of routing a gaseous fuel into the cylinder.

Claim 29 (new): The method of claim 26 wherein said mixing step includes a step of providing compressed air to the cylinder.

Claim 30 (new): The method of claim 26 wherein said adjusting step includes a step of enlarging said ignition delay at least in part by reducing a proportion of fuel with a high cetane number relative to fuel with a low cetane number.

Claim 31 (new): The method of claim 26 wherein said adjusting step includes a step of reducing said ignition delay at least in part by increasing a

proportion of fuel with a high cetane number relative to fuel with a low cetane number.

Claim 32 (new): The method of claim 26 including a step of adjusting combustion duration at least in part by recirculating exhaust gases into the cylinder.

Claim 33 (new): An engine comprising;
an engine housing with at east one cylinder;
a piston slidably positioned in each said at least one cylinder, and being movable between a bottom dead center position and a top dead center position;
a liquid fuel supply valve attached to said engine housing;
a gaseous fuel supply valve attached to said engine housing;
a controller in control communication with said fuel injector and said gaseous fuel supply valve, and being operable to actuate said fuel injector when said piston is closer to said bottom dead center position than said top dead center position.

Claim 34 (new): The engine of claim 33 wherein said fuel injector includes a nozzle tip located in said cylinder.

Claim 35 (new): The engine of claim 33 including an exhaust gas recirculation system attached to said engine housing.

Claim 36 (new): The engine of claim 33 including a turbocharger operably coupled to said cylinder.

Claim 37 (new): The engine of claim 33 wherein said controller includes an ignition delay adjuster operable to determine an adjustment to a proportion of a liquid fuel to a gaseous fuel supplied to said cylinder.